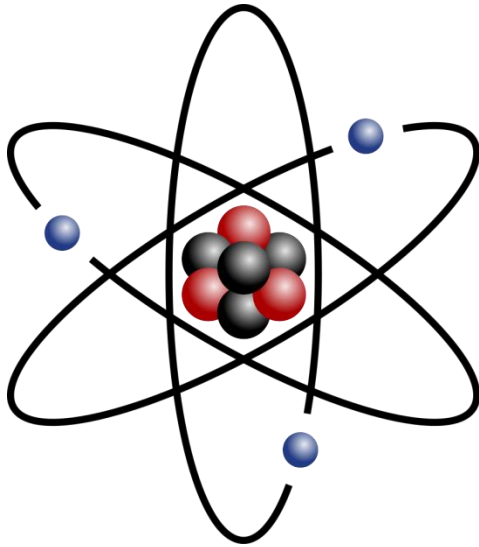




Department of
**Environment &
Conservation**

Management of Radioactive Materials (RAM) at Class 1 Landfills

Division of Radiological Health (DRH)



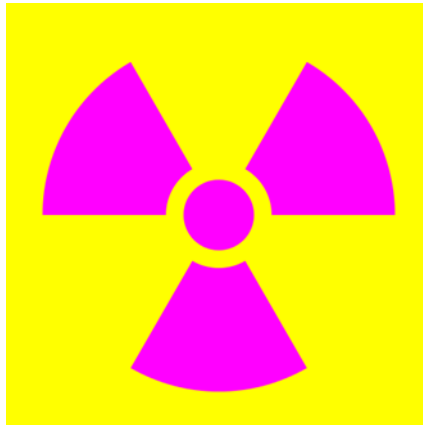
Tennessee Atoms

Mark Andrews, Knoxville Health Physicist Field Office
Allen Grewe, Health Physicist Field Office Manager
Jerry Bingaman, Radiation Safety Officer
April 20, 2016



Radioactive Material

Why Worry?



Class I Landfills

- Regulated by Tennessee Division of Solid Waste
- Designed for Municipal Solid Wastes
- Permits typically exclude receipt of radioactive materials except as allowed under “Special Waste” Permit.

Radioactive Materials

- Radioactive Materials in Tennessee regulated by the:

Tennessee Division of Radiological Health (DRH)

Definitions

- From Tennessee State Regulations for Protection Against Radiation (SRPAR) 0400-20-04 and 05 :
- **“Radioactive material”** means any material, solid, liquid or gas, which emits radiation spontaneously.
- **“NARM”** means any naturally occurring or accelerator-produced radioactive material. It does not include byproduct, source or special nuclear material.

- **Byproduct material” means:**

- (a) Any radioactive material (except special nuclear material) yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear material;
- (b) The tailings or wastes produced by the extraction or concentration of uranium or thorium from ore processed primarily for its source material content, including discrete surface wastes resulting from uranium solution extraction processes. Underground ore bodies depleted by these solution extraction operations do not constitute "byproduct material" within this definition;
- (c) 1. Any discrete source of radium-226 that is produced, extracted, or converted after extraction for use for a commercial, medical, or research activity; or
2. Any material that—
 - (i) Has been made radioactive by use of a particle accelerator; and
 - (ii) Is produced, extracted, or converted after extraction for use for a commercial, medical, or research activity; and
- (d) Any discrete source of naturally occurring radioactive material, other than source material, that—
 - » 1. The Commission, in consultation with the Administrator of the Environmental Protection Agency, the Secretary of Energy, the Secretary of Homeland Security, and the head of any other appropriate Federal agency, determines would pose a threat similar to the threat posed by a discrete source of radium-226 to the public health and safety or the common defense and security; and
 - » 2. Is extracted or converted after extraction for use in a commercial, medical, or research activity.

- **“Source Material”** refers to:
 - (a) Uranium or thorium, or any combination thereof, in any physical or chemical form; or
 - (b) Ores which contain by weight, one-twentieth of one percent (0.05%) or more of:
 - Uranium, thorium or any combinations thereof.
 - Source material does not include special nuclear material.

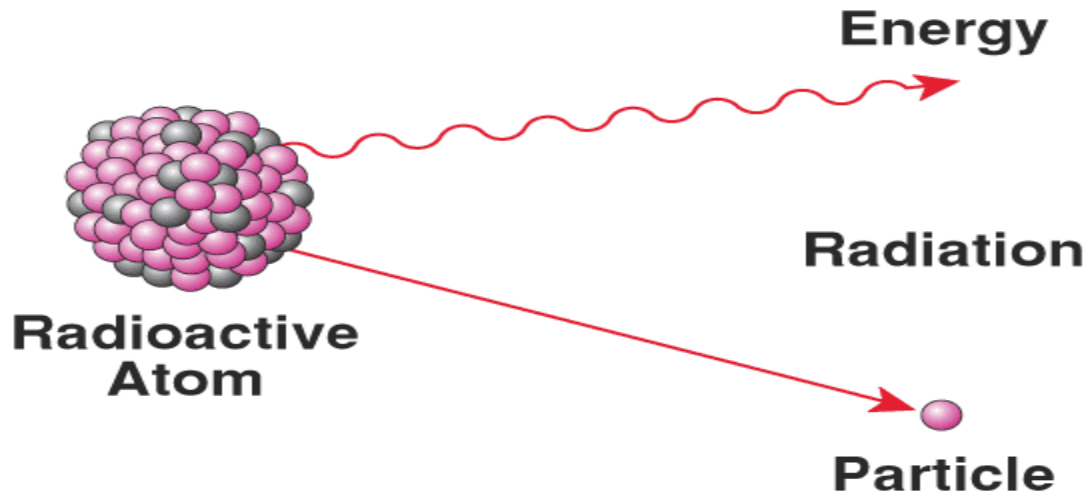
- **“Special Nuclear Material” (in quantities not sufficient to form a critical mass)** means:
 - 1. Uranium enriched in the isotope U-235 in quantities not exceeding 350 grams of contained U-235;
 - 2. Uranium-233 in quantities not exceeding 200 grams;
 - 3. Plutonium in quantities not exceeding 200 grams; or
 - 4. Any combination of them in accordance with the following formula. For each kind of special nuclear material, determine the ratio between the quantity of that special nuclear material and the quantity specified above for the same kind of special nuclear material. The sum of such ratios for all kinds of special nuclear material in combination shall not exceed 1 (i.e., unity). For example, the following quantities in combination would not exceed the limitation and are within the formula, as follows:

$$\frac{175 \text{ (grams contained U-235)}}{350} + \frac{50 \text{ (grams U-233)}}{200} + \frac{50 \text{ (grams Pu)}}{200} = 1$$

Hazardous Material

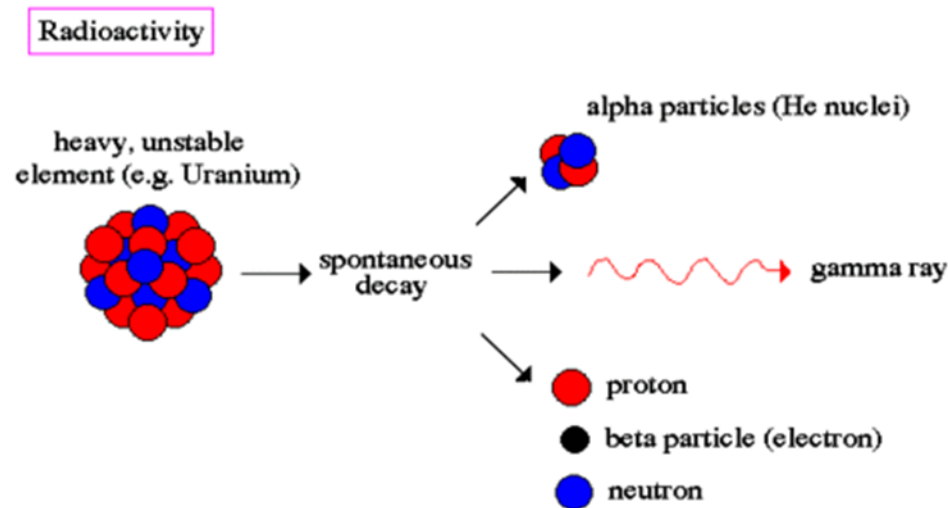
- U.S. Dept. of Transportation specifies regulations regarding transport of Hazardous Materials.
- 49 CFR Part 171.8 Defines Hazardous Material
- 49 CFR Part 173.403 Defines Radioactive Material
- **Radioactive Material is a Hazardous Material !!!!!**
- **Radioactive Material is subject to Haz Mat shipping regulations!!!!**

Characteristics of Radioactive Material



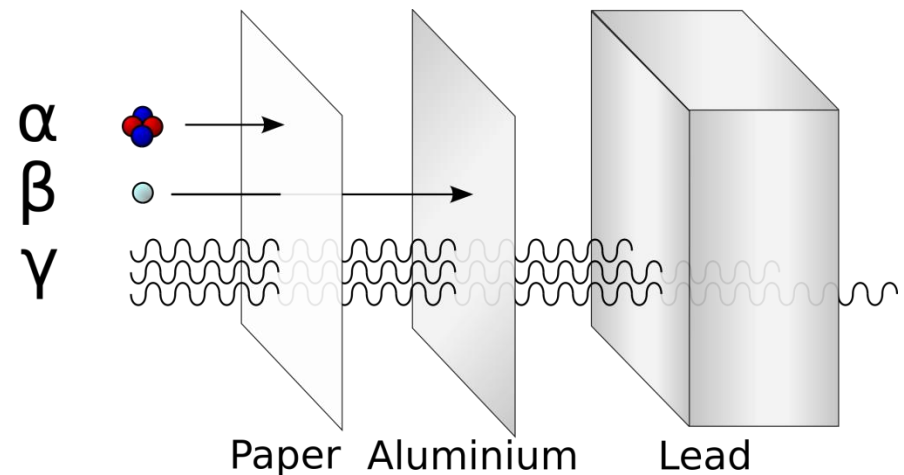
Radioactive Material

Unstable Atom trying to Become Stable



Characteristics of Radiation

- Alpha Radiation
 - Alpha radiation is a heavy, very short-range particle.
- Beta Radiation
 - Beta radiation is a light, short-range particle and is actually an ejected electron.
- Gamma and X-Ray Radiation
 - Gamma radiation and x rays are highly penetrating electromagnetic rad



Half-Life

Half-Life

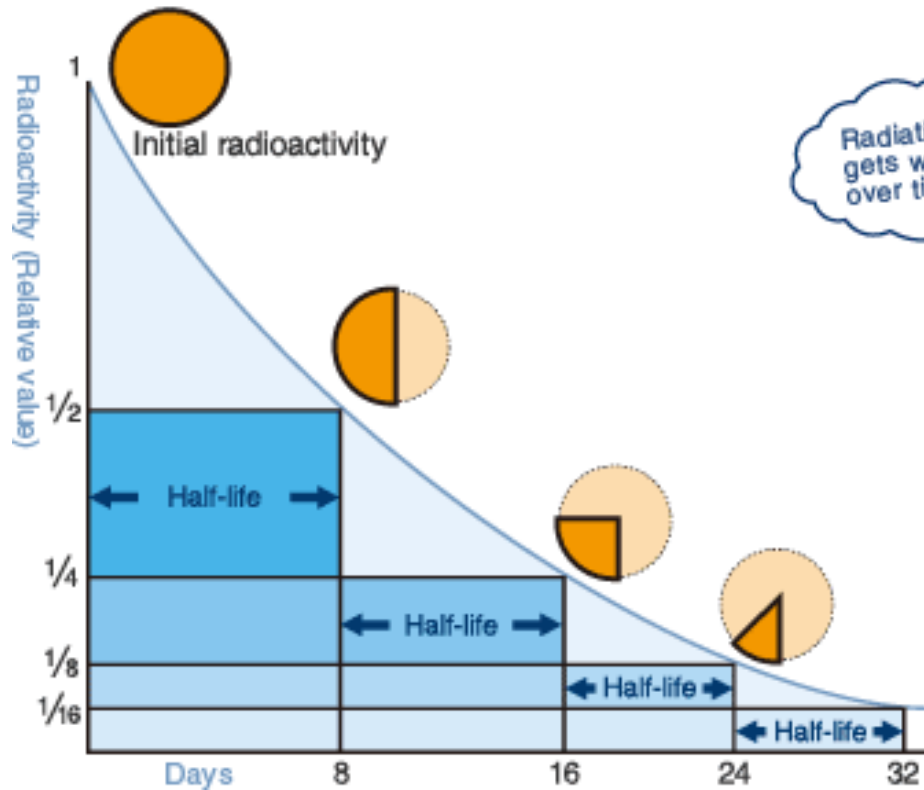


The time required for the amount of radioactive material to decrease by one-half



Half - Life

[How radioactivity decays] Iodine 131



Radiation gets weaker over time



Detection of Unwanted Radioactive Material

- Many landfills have radiation detection capability to identify the presence of radiation in incoming shipments
- Means vary considerably.
 - Low Tech - Low Efficiency Detection
 - Portable Hand Held Instruments
 - High Tech - High Efficiency Detection
 - Fixed Gate Monitor Systems with Multiple Spatially Oriented Detectors

Portable Hand Held Instruments



Scales/Gate Radiation Detection Monitors



Limitations of Gate Monitors

- Detects Only Gamma Radiation
- Very Sensitive, detects naturally occurring radioactive materials at very low levels.
- False alarms or nuisance alarms at low settings
- Flow Through/ Time Assessing Alarms
- Many types of radiation sources in environment from man made to naturally occurring.

What's Out There?



Common Isotopes & Characteristics

- Industrial
 - Cs-137 – Beta/Gamma Emitter – Half-Life 30 years
 - Co-60 - Beta/Gamma Emitter - Half-Life 5 years
 - Am-241 – Alpha/Gamma Emitter – Half- Life 432 years
- Medical
 - Tc-99m – Gamma Emitter – Half-Life 6 hours
 - I-131 - Beta/Gamma Emitter – Half -Life 8 days
- Naturally Occurring
 - Ra-226 – Alpha/ Gamma Emitter – Half-Life 1600 years
 - Thorium (Various Isotopes) and Daughter Products
 - Alpha/Gamma Emitter – Half-Life 25 hours to 1.41×10^{10} years
 - Uranium (Various Isotopes) and Daughter Products
 - Alpha/Gamma - Half-Life 1.62×10^5 years to 4.5×10^9 years

Examples

Industrial



Abandoned Nuclear Gauge Kr-85



Abandoned Nuclear Gauge Kr-85



Abandoned Nuclear Gauge Am-241



Cs-137 Contaminated Boat Trailer



Portable Nuclear Gauges Cs-137/Am-241



Naturally Occurring



Thorium Based Refractory Materials



Naturally Occurring Sources



Th-232/Source Material in Grit Blast Agent



Radium -226 Dial Military Gauges



Ra-226 Dial Compass



Ra-226 Source in old Analytical Equipment



Ra-226 Scale Plating Out from Water



Medical



Medical Related Waste Sources

- Personal Products from Outpatients Administered RAM
- Diapers from Incontinent Patients
- Improperly Released Hospital Nuclear Waste
- Sludge from Waste Water Treatment Plants with Patient/Outpatient Excreta

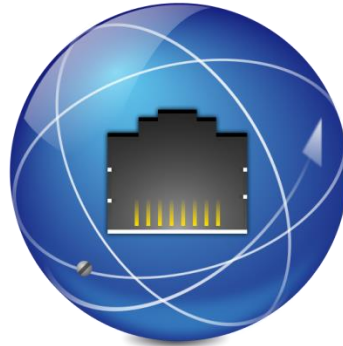
Diapers



Nuclear Medicine Waste



Exempt Products/Materials



Exempt Source Material



Exempt – Thorium Glass



Exempt Products – Smoke Detectors

Am-241



Exempt – NORM - K-40 / Source Material



What to Do?



Be Aware for Labels/Tags



Radiation Detection System Alarms

- **If alarm of radiation detection system or material suspect:**
 - **Isolate and secure suspect material in non-occupied area.**
 - **Contact Div. Radiological Health and notify.**
 - **Await response for assessment of risk and identification of source of radiation**

DRH Response

- Necessary to determine identity and risk of material causing alarm and assess impact on health to public and workers exposed.
- Necessary to investigate source of radioactive materials and determine if health risks to public exist which need to be addressed or if regulated industry violations occurred.
- Necessary to allow issuance of an exemption to USDOT Hazardous Materials regulations to allow legal return of shipment to point of origin, if necessary.

Memphis Area Landfill



Memphis Area Landfill



Abandoned Nuclear Gauges



Secur: 10:19:50 1123 gCPS

ID Key:

IND SNM MED 96.2 µrem/hr

NRM UNC UNK C/B

10 k

1.0k

100

10

1.0

0MeV 1MeV 2MeV 3MeV

Acquisition complete in 33 sec

Cancel Erase -30 s +30 s

BACK

MENU

ENTER

Abandoned Nuclear Gauge Am-241



Public Dose Limit Standards

- SRPAR 0400-20-05-.60 Specifies Dose Limits for Individual Members of the Public:

< 2 millirem in any one hour

< 100 millirem in one year

Possible Outcomes



Possible Outcomes

The Good!



Possible Outcomes

- **If short-lived RAM and point of origin not identifiable:**
 - DRH might recommend allowing burial of material in isolated cell with no handling or contact.
 - DRH might recommend holding for a few days for material to decay to background levels then allow burial.

Possible Outcomes

- **If Long-Lived RAM and point of origin/responsible party identifiable:**
 - Return Suspect Material to source of origin if source identifiable and material meets conditions for Dept. of Transportation Hazardous Materials regulations Special Permit.
 - DRH only agency authorized to issue exemption to the hazardous materials regulations for transport of material back to site of origin. Otherwise, transport may not be in compliance with US DOT Hazardous Materials regulations.

Possible Outcomes

- **If Exempt Material, or Naturally Occurring or of Low Consequence and Not Regulated:**
 - DRH might recommend allowing burial of material without regard to its radioactivity.

Possible Outcomes

The Bad!



Possible Outcomes

- **If Long-Lived RAM and point of origin/responsible party not identifiable:**
 - Isolate and secure suspect material in non-occupied area.
 - If material requires disposition as radioactive waste, landfill may become responsible for proper disposition of material.

Possible Outcomes

The Ugly!



Possible Outcomes

- **If material determined to be Immediately Dangerous to Life and Health:**
 - Emergency Measures to secure source from public arena
 - Assess impact on public and employees

History



Landfill Responses by DRH

	2014	2013	2012
Total	6	7	26
Good	6	6	26
Bad	0	1	0
Ugly	0	0	0

Most Common Events

Most Common type event is short lived Medical Waste in very low levels which will typically be allowed to be buried due to material becoming non-radioactive from decay in very short period of time.

It's a



World Out There!

Radiological Health Contact Information

Division of Radiological Health

- **Working Hours: 615-532-0364**
- **24 Hour Emergency Number: 800-262-3300**

Contact Information:

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